1908MNRAS..68..198S

On the Orbit of β 552 = 11 *Orionis.*

By T. J. J. See, A.M., Ph.D. (Berol.).

This interesting binary was discovered by Burnham with the 18½-inch refractor at Chicago in 1877, but it had been previously suspected with the 6-inch in 1874 as "possibly a close pair." The place for the epoch 1880 is $\alpha = 4^h\ 45^m\ 4^s$; $\delta = +13°\ 27'$; and the magnitudes are 7·0 and 10·0. It is therefore an exceedingly difficult object, and can be well seen only in the most powerful telescopes, under good conditions. On two favourable nights in 1892 Burnham could not see it with the 36-inch refractor of the Lick Observatory. Professor Hermann Struve, with the 30-inch refractor at Pulkowa, had suspected the companion on the opposite side in 1886, when the distance was only 0″·21; but as his angle corresponds to the true place at the time, I have reversed it, on the supposition that the point of the diffraction fringe noted was produced by the companion, which was then too close for separation, but might easily produce an opposite image resembling a real companion.

This system is highly inclined upon our visual ray. The components being so unequal, the observations are somewhat discordant. After a careful study of the movement, I have deduced the following elements:—

P = 56·0 years
T = 1887·0
e = 0·345
a = 0″·528

☊ = 4°·1
i = 56°·7
λ = 90°·2

Apparent orbit:—

Length of major axis = 1″·00
Length of minor axis = 0″·59
Angle of major axis = 4°·2
Angle of periastron = 94°·4
Distance of star from centre = 0″·10

Comparison of computed with observed places for
β 552 = 11 *Orionis.*

t	θ_o	θ_c	$\theta_o-\theta_c$	ρ_o	ρ_c	$\rho_o-\rho_c$	Observer, Nights.
	°	°	°	″	″	″	
1874·95	340·±	348·6	− 8·6	0·5±	0·51	−0·01±	β.
1877·97	360·±	359·5	+ 0·5	0·8±	0·49	+0·31±	β, 1.
1886·19	85·0 ?	74·5	+10·5	0·5±	0·21	+0·29±	H Σ, 1; angle is here reversed.
1889·19	144·7	141·2	+ 3·5	0·35±	0·25	+0·10±	Sp., 1.
1890·96	156·7	161·4	− 4·7	0·33	0·34	−0·01	β, 3.
1891·13	153·8	162·8	− 9·0	0·33	0·34	−0·01	Sp., 8.
1892·06	...	169·3	...	...	0·38	...	β, 2; apparently single with 36-inch.

1908MNRAS..68..198S

t	θ_o	θ_c	$\theta_o-\theta_c$	ρ_o	ρ_c	$\rho_o-\rho_c$	Observer, Nights.
1893·07	165°·3	175°·5	−10°·2	0″·35±	0″·42	−0″·07	Sp., 1.
1894·15	178·2	181·1	− 2·9	0·38	0·45	−0·07	Sp., 2.
1894·88	177·0	184·3	− 7·3	0·40	0·47	−0·07	Bax., 2.
1896·11	179·9	188·8	− 8·9	0·35	0·49	−0·12	Sp., 7.
1896·86	187·0	192·1	− 5·2	0·42	0·50	−0·08	Hu., 1 ; A., 3.
1897·63	193·5	194·9	− 1·4	0·37	0·50	−0·13	Sp., A., 5 ; Hu., 3.
1898·01	189·9	197·7	− 7·8	0·45	0·50	−0·05	Lewis, 2.
1898·43	198·1	197·8	+ 0·4	0·44	0·51	−0·07	A., 6.
1899·76	202·5	202·0	+ 0·5	0·45	0·51	−0·06	See, 1 ; A., 4.
1899·85	207·3	202·8	+ 4·5	0·42	0·51	−0·09	Lewis, 3.
1900·71	204·3	205·9	− 1·6	0·45	0·51	−0·06	A., 3 ; Doo., 3.
1901·85	204·6	210·1	− 5·5	0·49	0·50	−0·01	A., 2 ; Doo., 2.
1902·74	229·3	212·6	+16·7	0·32	0·50	−0·18	β, 1.
1903·66	218·9	216·8	+ 2·1	0·46	0·49	−0·03	A., 4 ; Biesbroeck, 2.
1905·90	227·9	225·9	+ 2·0	0·46	0·46	±0·00	A, 2.
1907·93	238·7	235·1	+ 3·6	0·55	0·44	+0·11	Doo., 3.

Ephemeris.

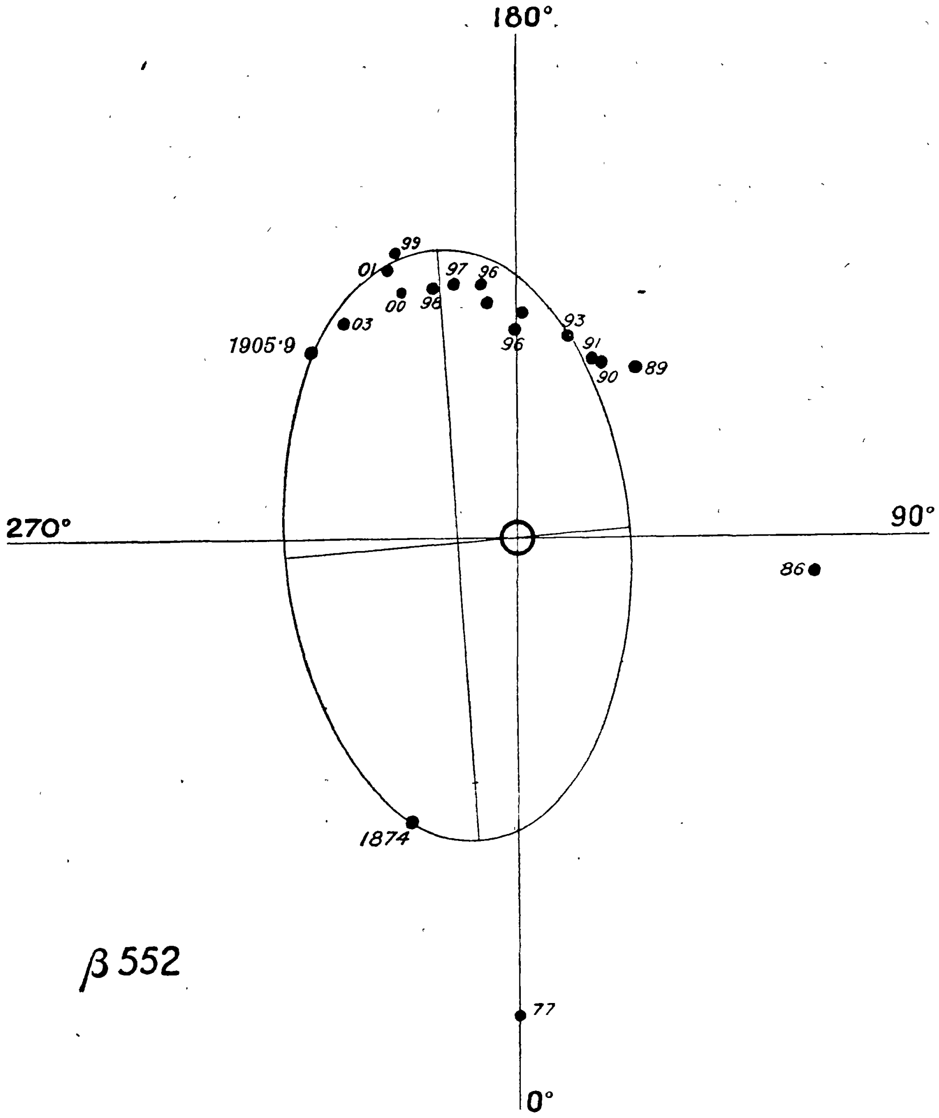
t	θ_c	ρ_c	t	θ_c	ρ_c
1907·0	230°·9	0″·45	1913·0	262°·3	0″·39
1908·0	235·5	0·44	1914·0	268·4	0·39
1909·0	240·5	0·43	1915·0	274·5	0·39
1910·0	245·6	0·42	1916·0	280·6	0·39
1911·0	250·6	0·41	1917·0	286·5	0·39
1912·0	256·3	0·40	1918·0	292·4	0·40

The accompanying table shows the comparison of the computed with the observed places. Considering the discordance of the measures, the representation in angle is good. The distances could be slightly improved by reducing the major axis; but as the scale of distance is still somewhat uncertain, I have not thought it worth while to do this. It seems certain that these elements give the essential character of the motion, which is rendered very peculiar by the high inclination, giving a nearly stationary phase at each end of the apparent orbit. The orbit of β 552 has some resemblance to that of γ Coronæ Borealis, the components of which are correspondingly unequal and difficult to measure.

It is clear that the periastron was swept over about 1887·0, and that the period is about fifty-six years. The eccentricity may be higher than that given here, but an increase in this element

1908MNRAS..68..198S

would hardly be warranted by the existing observations. The ephemeris will be useful to observers, and it is to be hoped that



they will continue to follow this interesting object for a number of years, till the orbit can be adequately confirmed.

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1908MNRAS..68..198S

Note on the Comparative Eccentricities of Visual and Spectroscopic Binary Stars. By T. J. J. See, A.M., Ph.D. (Berol.).

For some time the writer has been occupied with a critical examination of the comparative eccentricities of visual and spectroscopic binary stars, in the hope of obtaining an observational criterion that will throw light on the evolution of these systems. It is now clear that the investigation will afford the criterion sought; and as he recently had occasion to mention the general result in letters to some friends abroad, it seems likely that a preliminary notice of this work may be of interest to the Society.

If we exclude from consideration all binaries telescopically resolvable in modern instruments, there remain about 30 orbits of purely spectroscopic binaries, which have been worked out from spectrograms taken chiefly at the Lick, Yerkes, and Potsdam Observatories. The eccentricity is well determined, and the average value for these 30 systems is about 0·22. In the case of very rapid binaries, with periods often much less than a day, the orbits are practically circular. Dr. A. W. Roberts and Professor G. W. Myers have investigated the light changes of certain variables, and shown that they are composed of two stars in the process of separation, and therefore revolving in orbits which are without sensible eccentricity.

The average eccentricity of visual binary stars remains about 0·50, as indicated in the work *Researches on the Evolution of the Stellar Systems*, vol. i., published in 1896. The subject has, however, been so much extended and improved during the past eleven years that it has seemed advisable to re-examine each orbit anew. There are about 80 orbits in which the eccentricity may be fairly well determined. I hope to have the final result of this examination ready for presentation to the Society in a short time. The work is already so far advanced that we may confidently state that *the average eccentricity among visual binaries is considerably more than twice that among the spectroscopic binaries.* The latter are stellar systems, with components so close together, owing to the small size of their orbits, or so far removed from us in space, that we cannot resolve them even in the greatest of modern telescopes. In some cases they are closer sub-systems of known visual binary stars. Among such systems we may mention ξ Ursae Majoris, κ Pegasi, α Geminorum, etc., which are spectroscopically subdivided in exact analogy to the many double stars which have been resolved into triple stars by increase of modern telescopic power; but where the spectroscopic binaries stand alone, we can infer the average size of their orbits only from the generalised form of Kepler's law.

For a large number of systems we are justified in assuming that the average mass will be the same among the spectroscopic as among the visual binary stars. And as the periods of the spectroscopic binaries are much shorter than those of the visual binaries, it